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COST- BENEFIT ANALYSIS: PATIENT CARE AT NEUROLOGICAL INTENSIVE CARE UNIT

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SUMMARY – Modern quality definition relies on patient centeredness and on patient needs for particular services, continuous control of the service provided, complete service quality management, and setting quality indicators as the health service endpoints. The health service provided to the patient has certain costs. Thus, one can ask the following: "To what extent does the increasing cost of patient care with changes in elimination improve the quality of health care and what costs are justifiable?" As stroke is the third leading cause of morbidity and mortality in Europe and worldwide, attention has been increasingly focused on stroke prevention and providing quality care for stroke patients. One of the most common medical/nursing problems in these patients is change in elimination, which additionally affects their mental health.

Key words: *Intensive care units; Cost-benefit analysis; Stroke – nursing; Nursing care – economics; Quality of health care – economics; Quality of health care – nursing*

Introduction

The pattern of demographic changes in the society indicates a steady increase in the elderly population, resulting in ever greater proportion of individuals requiring health care service at primary and secondary levels. This in turn implies increasing efforts of those involved to provide quality health care to our patients. As stroke is the third leading cause of morbidity and mortality in Europe and worldwide, attention has been increasingly focused on stroke prevention and providing quality care for stroke patients. One of the most common medical/nursing problems in these patients is change in elimination, which additionally affects their mental health. As ensuring quality health care is currently in the focus of interest, all health care professionals tend to provide it, which is even more emphasized in health care for neurological patients. Obviously, great advances have been made in the field, in line with changes we face daily in our practice. In addition, modern quality definition relies on patient centeredness and on patient needs for particular services, continuous control of the service provided, complete service quality management, and setting quality indicators as the health service endpoints[1].

The health service provided to the patient has certain costs. Thus, one can ask the following: "To what extent does the increasing cost of patient care with changes in elimination improve the quality of health care and what costs are justifiable?" The present study was based on the financial structure of neurological patient health care with changes in elimination by use of a quality aid as compared with classic care. Personnel cost was analyzed along with material cost[2].

The Intensive Care Unit of the Department of Neurology, as part of intensive and interventional neurology, provides care for a group of neurological patients who require either measures of intensive

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medical treatment (due to the nature of the neurological disorder or the general condition of the patient), or a specific form of an interventional neurological or neuroradiological treatment.

The vast majority of urgently admitted or transferred patients suffer from cerebrovascular diseases, primarily patients with acute and/or subacute stroke or brain hemorrhage. The treatment within the Unit includes other patients requiring intensive treatment as well, such as those requiring continuous monitoring, mechanical ventilation and/or intensive care. These are most frequently patients in status epilepticus, patients with myasthenic crisis, acute polyradiculitis or patients with rare diseases with manifestations in the form of neurological symptoms and requiring intensive medical care.

The aim of the study was cost determination of patient care with the use of a quality aid relative to classic care without quality aid, with special reference to changes in elimination.

Material and Methods

The study included a sample of 224 patients admitted to the Neurological Intensive Care Unit (NICU), University Department of Neurology, Sestre milosrdnice University Hospital Center, during a 4-month period (February through May 2011). A list of data designed exclusively for research purposes and modified according to neurological patient needs was used to follow patient needs during NICU stay with special reference to elimination. Besides data from the list, other data necessary for the study were obtained by direct questions and personnel performance observation. Statistical analysis included follow up of absolute and relative frequency of the events observed and arithmetic means expressing the needs. Data were collected, analyzed and validated. Direct health care indicators were calculated from data obtained on personnel (nurse) time required for solving elimination problems, and cost of this time. Expendable supplies used on elimination (urinary catheters, urinary bags, diapers and rubber clothes) as required by each individual patient during NICU stay, as well as the time invested by laundry personnel, water and electricity consumption for washing, drying and ironing exclusively for NICU were included in the analysis. Table 1 shows patient data observed during NICU stay and data obtained by direct questions posed to the Hospital technical personnel. All necessary information on the methods of work, time and tariff for washing, drying, ironing and distribution of hospital lining was obtained by posing questions, making rounds and observing the procedures, talking to technical personnel and laundry workers. In order to get real cost structure, indirect indicators such as monthly salary of laundry workers, and hourly wage of laundry workers and NICU staff were also taken in consideration.

Comparison of cases managed with the use of quality aid and classic patient care required setting of certain prerequisites, in this case supported by the rich experience of staff members with long-standing work at NICU. The prerequisites implied assessment of the time required for classic patient management *versus* patient management with the use of a quality aid.

Table 1. Patient data observed

Hospital laundry service								
Electricity (washing machines, drying machines, ironing)						Detergent	Workers	Water (m^3)
Power (kW)	Time	Energy (kW/h)	Price 1kW/h	Usage cost (kW/h) HRK	Laundry electricity cost	Price g/kg laundry	Hourly wage Monthly salary	Washing machines Ironing
Cost of patient care during NICU stay								
Time invested in patient care				Nurse hourly wage	Expendable supplies			
Urinary catheters	Urinary bags	Urinals	Diapers		Urinary catheters	Urinary bags	Diapers	Rubber clothes

Table 2. Total laundry cost: cases managed with the use of quality aid

Laundry						
Electricity						
	Power kW	Time h	Energy kWh	Price 1 kWh	Price HRK/kWh	Price (Neurology)
Washing machines	120	2	240	0.63 HRK	151.20 HRK	9.45 HRK
Drying	6	0.8	4.8	0.63 HRK	3.02 HRK	3.02 HRK
Ironing	15	16	240	0.63 HRK	151.20 HRK	9.45 HRK
Laundry detergent						
Washing machines	20 g/kg	-	1600			16 HRK
Staff						
35			100 HRK/day		3500 HRK	218.75 HRK
Water						
	Capacity m^3	Time h	Total water	Price 1 m^3	Total price	Price (Neurology)
Washing machines	23	1	23	29	667.00 HRK	41.69 HRK
Ironing	0.5	16	8	29	232.00 HRK	14.50 HRK
					1 day	312.86 HRK
					1 month	9385.85 HRK
					4 months	37543.38 HRK

Ethical Considerations

"The act of caring for ill persons is not passive, but rather active, as it implies helping the patient for him/her to question and regain the meaning of life and to revive life plans based on personal and social values. Caring for ill persons is considered to be above all a moral action and throughout history has been related to the idea of compassion, sympathy and helping in trouble."[3].

Results and Data Analysis

Study results are presented in three logical units, as follows: laundry (Table 2, 2a), nurses (Table 3, 3a) and expendable supplies (Table 4, 4a).

Laundry

As shown below, this item accounted for the largest portion of the elimination related cost. We had to know the amount of linen used *per* 24 h at NICU and the overall amount of linen at the Hospital. Total laundry cost was obtained from data on the consumption of electricity (washing machines, drying machines and ironing machines), water and detergent, and personnel work.

The laundries operate 5 washing machines daily to meet the needs of the NICU. The electricity consumption for laundry is 120 kW. The daily cost is 37.80 HRK for classic aid and 9.45 HRK for quality aid. During the drying procedure, the energy consumption is 6 kW, which in terms of consumption price amounts to 15.12 HRK for classic aid and 3.02 for quality aid. During the ironing procedure, the energy consumption is 15 kW of electrical power unit, which in terms of price amounts to 9.45 HRK for quality aid (Table 2) and 37.80 HRK for classic aid (Table 2a).

The consumption of laundry detergent is shown by g of detergent required *per* kg of bedclothes. Twenty g of laundry detergent is used *per* kg of bedclothes. The daily consumption of laundry detergent for bedclothes is 1600 g, which amounts to 16 HRK for the washing of the bedclothes of patients whose elimination problem is managed with quality aid (Table 2) and 80 HRK for the washing of the bedclothes of patients

Table 2a. Total laundry cost: cases managed with classic patient care

Laundry						
Electricity						
	Power kW	Time h	Energy kWh	Price 1 kWh	Price HRK/kWh	Price (Neurology)
Washing machines	120	2	240	0.63 HRK	151.20 HRK	37.80 HRK
Drying	6	4	24	0.63 HRK	15.12 HRK	15.12 HRK
Ironing	15	16	240	0.63 HRK	151.20 HRK	37.80 HRK
Laundry detergent						
Washing machines	20 g/kg	-	8000			80 HRK
Staff						
35			100 HRK/day		3500 HRK	875.00 HRK
Water						
	Capacity m^3	Time h	Total water	Price 1 m^3	Total price	Price (Neurology)
Washing machines	23	1	23	29	667.00 HRK	166.75 HRK
Ironing	0.5	16	8	29	232.00 HRK	58.00 HRK
					1 day	1270.47 HRK
					1 month	38114.10 HRK
					4 months	152456.40 HRK

whose elimination problem is managed with classic aid (Table 2a).

The bedclothes maintenance service staff represents the most expensive item in the cost-benefit analysis. As indirect support system, they are allocated in two working shifts, a total of 16 hours during a 24-hour period. The aforementioned bedclothes maintenance system includes a total staff number of 35 persons. When using quality aid in elimination problems management, the daily staff labor cost is equal to 875 HRK (Table 2); when using classic aid, the same amounts to 218.75 HRK (Table 2a).

Under the assumption that 80 kg of bedclothes is needed daily when the elimination problem is managed with quality aid and 130 kg of bedclothes is needed when the elimination problem is managed with classic aid, the daily cost amounts to 41.69 HRK in the first case and 166.75 HRK in the second case (Table 2a). Irrespective of the type of aid used, 23 m^3 of bedclothes are used daily.

The ironing costs are calculated *per* m^3 of bedclothes; for the same weight of bedclothes used for the calculation of water consumption, the cost is 14.50 HRK when using quality aid (Table 2) and 58 HRK when using classic aid (Table 2a).

Nurses

The cost of managing elimination problems by NICU nurses was obtained by monitoring the frequency of particular procedures (placement of urinary catheters, changing urinary bags, urinal placement, placement of diapers, and patient personal hygiene) and recording the time invested for each procedure *per* time unit.

For the purpose of analysis, it is assumed that during a 24-hour period, diapers must be changed 4 times in a patient. If the patient wets the bed the same number of times, the time of the nurse providing service and the number of procedures of the nurse will increase, just as the bedclothes maintenance cost.

Expendable supplies

The cost of expendable supplies required for the management of elimination problems was obtained by monitoring consumption of these materials and recording the price of each material.

Table 3. Total nurses cost

Elimination management costs						
	Min	Pcs.	Total minutes in 4 months	Total minutes in 1 month	Total minutes in 1 day	
Urinary catheters	10.00	73.00	730.00	182.50	6.08	
Urinary bags	3.00	576.00	1728.00	432.00	14.40	
Urinal/bedpan	3.00	72.00	216.00	54.00	1.80	
Diapers	9.00	2506.00	22554.00	5638.50	187.95	
	0.00		0.00	0.00	0.00	
Nurses hourly rate (gross) 52.52 HRK						
			420.47	105.12	3.50	Total hours
			70.08	17.52	0.58	Hours *per* nurse
			3680.48 HRK	920.12 HRK	30.67 HRK	Cost *per* nurse
			22082.91 HRK	5520.73 HRK	184.02 HRK	Cost *per* staff

Table 3a. Total nurses cost

Elimination management costs						
	Min	Pcs.	Total minutes in 4 months	Total minutes in 1 month	Total minutes in 1 day	
Urinary catheter	10.00	73.00	730.00	182.50	6.08	
Urinary bags	3.00	576.00	1728.00	432.00	14.40	
Urinal/bedpan	3.00	72.00	216.00	54.00	1.80	
Washing without diapers	13.50	2506.00	33831.00	8457.75	281.93	
	0.00		0.00	0.00	0.00	
Nurses hourly rate (gross) 52.52 HRK						
			608.42	152.10	5.07	Total hours
			101.40	25.35	0.85	Hours *per* nurse
			5325.67 HRK	1331.42 HRK	44.38 HRK	Cost *per* nurse
			31954.04 HRK	7988.51 HRK	266.28 HRK	Cost *per* staff

The analysis showed that during 4 months of elimination problems management, more expendable supplies were used for patients managed with quality aid than for patients managed with classic aid.

The data presented were collected at NICU, where patient management is carried out by use of quality aids. Data on the classic management of elimination problems were deduced by increasing the presumed utilization of hospital linen and time of patient management by nurses. Study results are shown in Table 5.

Results obtained by the analysis of costs for the management of patient elimination problems by use of a quality aid are presented in the left panel, while the right panel shows the respective results for the classic management of elimination problems.

In the final statement of cost for the management of elimination problems with classic aid, the total cost amounts to 190,091.31 HRK, and for the management of elimination problems with quality aid to 71,033.96 HRK. The cost-benefit analysis shows a saving in the amount of 119,057.35 HRK.

Table 4. Total cost of expendable supplies

Expendable supplies					
	pcs/24 h	Unit price	Price *per* day	Price *per* 1 month	Price in 4 months
Urinary bags	4.8	1.79	8.59 HRK	257.76 HRK	1031.04 HRK
Urinary catheters	0.608	2.84	1.73 HRK	51.80 HRK	207.21 HRK
Diapers	20.88	3.29	68.70 HRK	2060.86 HRK	8243.42 HRK
Rubber clothes	25	1.02	25.50 HRK	765.00 HRK	3060.00 HRK
Total			104.51 HRK	3135.42 HRK	12541.67 HRK
Final cost					
	1 day	1 month	4 months		
Laundry	312.86 HRK	9385.85 HRK	37543.38 HRK		
Nurses	184.02 HRK	5520.73 HRK	22082.91 HRK		
Expendable supplies	104.51 HRK	3135.42 HRK	12541.67 HRK		
Total	601.40 HRK	18041.99 HRK	72167.96 HRK		

Table 4a. Total cost of expendable supplies

Expendable supplies					
	pcs/24h	Unit price	Price *per* day	Price *per* 1 month	Price *per* 4 months
Urinary bags	4.8	1.79	8.59 HRK	257.76 HRK	1031.04 HRK
Urinary catheters	0.608	0.82	0.50 HRK	14.96 HRK	59.83 HRK
Diapers	0	3.29	0.00 HRK	0.00 HRK	0.00 HRK
Rubber clothes	37.5	1.02	38.25 HRK	1147.50 HRK	4590.00 HRK
Total			47.34 HRK	1420.22 HRK	5680.87 HRK
Final cost					
	1 day	1 month	4 months		
Laundry	1270.47 HRK	38114.10 HRK	152456.40 HRK		
Nurses	266.28 HRK	7988.51 HRK	31954.04 HRK		
Expendable supplies	47.34 HRK	1420.22 HRK	5680.87 HRK		
Total	1584.09 HRK	47522.83 HRK	190091.31 HRK		

Discussion

The results of this study answer the question posed at the beginning affirmatively: "Is a quality aid at the same time an economical aid?" Economical aid enables quality performance, but it is not the only solution for quality care free from complications during patient hospital stay. Data from quality control monitoring on the absence of urinary infections, diaper rash, fungal inflammation and decubitus ulcers during the study support the quality of work, suggesting that providing quality care with the use of quality aid can result in cost savings at long term while reducing consumption for parallel services. The costs and the quality of care should be properly balanced. Providing quality care requires good practice, which is closely related to education; this will then result in quality health care at a rational cost. Work standards, control of nursing time utilization and performance quality control make the basis upon which nursing practice should rely.

Continuous, systematic standardized collection, analysis and interpretation of data related to plans for

Table 5. Total cost analysis

Cost analysis						
Quality aid				Classic management		
	24 h	1 month	4 months		24 h	1 month	4 months
Laundry	312.86 HRK	9385.85 HRK	37543.38 HRK	Laundry	1270.47 HRK	38114.10 HRK	152456.40 HRK
Nurses	184.02 HRK	5520.73 HRK	22082.91 HRK	Nurses	266.28 HRK	7988.51 HRK	31954.04 HRK
Expendable supplies	104.51 HRK	3135.42 HRK	12541.67 HRK	Expendable supplies	47.34 HRK	1420.22 HRK	5680.87 HRK
Total	601.40 HRK	18041.99 HRK	72167.96 HRK	Total	1584. 09 HRK	47522.83 HRK	190091.31 HRK

permanent training and comparison with health statistics can be useful in the educational system when creating programs that will result in competent and competitive workers. Determination of priorities, ongoing program evaluation and research encouragement can be of utmost importance to support individuals and groups in career management and professional development[4].

Conclusion

Data presented in this study indicate the cost of managing elimination problems to be lowered more than twice with the use of quality aid as compared with classic management. In both cases, hospital linen maintenance accounted for the largest portion of related costs; however, with classic management it was fourfold that recorded with the use of quality aid. This cost increase was additionally generated by longer time required for patient care provided by nurses. The only saving recorded with classic management relative to quality aid management referred to the cost of expendable care supplies; however, due to the low share of these supplies in the overall cost, this finding was not in favor of quality aid nonutilization.

Implications for Nursing Practice

Good organization of the implementation of health care in hospitals, which is always based on well-educated and competent nurses, can significantly affect the overall success of treatment that has the expert and financial effects. Since nurses in a hospital care carry out more than 80% of all the procedures in 24 hours, their impact on the total care is proportional to their share in the health care. It should be noted that nurses' expertise is most important but so are other elements: a sufficient number of nurses, good distribution based on changing needs, good equipment and accessories for the implementation of health care and space conditions[5].

Limitations to the Study

Costs and losses as the consequence of investment in an enterprise are flat and certain, while the income and benefits are for the long run and uncertain. This complicates the procedure of the cost-benefit analysis, particularly when facing only the benefits, which are indirect and contribute to the effects of the users, in this case the patients. It is, for instance, easy to establish the costs and losses of the application of a useful aid for stool and urine elimination, but it is much more complicated to establish the economic benefits for numerous users of such aids arising from improved health care. It is impossible and even unnecessary to quantify the costs and losses arising from devastation of the environment by inappropriate diapers and waste water after the washing of bedclothes and the benefits arising from faster and simpler elimination management. In any case, the higher the investments the more complicated is the cost-benefit analysis because of the greater number of variables, the service life is long and the uncertainty or risk is more increased.

Conflict of Interest

The cost-benefit analysis should only be used in cases when it is not simple to quantify the economic benefits for the investor. Aside from the mentioned major projects, these include investments in IT, advisory services, restructuring, reengineering, know-how. In fact, the cost-benefit analysis is an important template when deciding whether we should make any changes or we are going down the right path. Still, in our practice the cost-benefit analysis is used very rarely because it includes projects, which are decided upon by the politics.

However, from the position of establishing development priorities in the infrastructure, the cost-benefit analysis is indispensable.

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Sažetak

ANALIZA ISPLATIVOSTI: BOLESNIČKA SKRB U NEUROLOŠKOJ JEDINICI INTENZIVNOG LIJEČENJA

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Suvremena definicija kvalitete temelji se na usredotočenosti na bolesnika i na njegove potrebe za određenim uslugama, stalnoj kontroli pružene usluge, upravljanju kvalitetom sveukupnih usluga i utvrđivanju pokazatelja kao konačnih ciljeva zdravstvene službe. Zdravstvena usluga koja se pruža bolesniku ima određenu cijenu. Tako se može postaviti slijedeće pitanje: "U kojoj mjeri povećanje troškova skrbi za bolesnika s promjenama u eliminaciji poboljšava kvalitetu zdravstvene skrbi i koji su troškovi opravdani?" Kako je moždani udar treći vodeći uzrok pobola i smrtnosti u Europi i u svijetu, pozornost se sve više posvećuje sprječavanju moždanog udara i pružanju kvalitetne skrbi bolesnicima s moždanim udarom. Kod ovih bolesnika promjene u eliminaciji, što dodatno utječe na njihovo psihičko zdravlje, jedan su od najčešćih medicinskih i sestrinskih problema.

Ključne riječi: *Jedinice za intenzivnu skrb; Troškovi – analiza; Moždani udar – sestrinstvo; Sestrinska skrb – ekonomika; Kvaliteta zdravstvene njege – ekonomika; Kvaliteta zdravstvene njege - sestrinstvo*